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- Fig. 16. *Thuricolopsis innixa*.
 17. *Thuricolopsis Kellicottiana*.
 18. *Platycola cælochila*.
 19. *Lagenophrya patina*.
 20. *Histrio erethesticus*.
 21. *Solonophora odontophora*.
 22. *Acineta bifaria*.

- Fig. 23. *A. bifaria*. Reproductive
 fission.
 24. *A. bifaria*. Embryo.
 25, 26. *Acineta macrocaulis*.
 Pedicle omitted.
 27. *Acineta acuminata*.

Preliminary Report on the Vertebrate Fossils of the Uinta Formation, collected by the Princeton Expedition of 1886. By W. B. Scott and Henry F. Osborn.

(Read before the American Philosophical Society, Sept. 2, 1887.)

The Uinta formation, which was first identified by Prof. Marsh, is one of great interest, as it is just intermediate between the Bridger and the White River groups. It has as yet been comparatively little explored, and much remains to be done, but enough is now known to render possible some account of this most important intermediate fauna.

REPTILIA.

Crocodylus, sp. indet.

Trionyx, sp. indet.

MAMMALIA.

LEMUROIDEA.

Hyopsodus gracilis Marsh.

CREODONTA.

Mesonyx uintensis Scott.

CARNIVORA.

Amphicyon (?) *vulpinum*, sp. nov.—The probable existence of this genus in the Uinta beds is indicated by a lower premolar and lower sectorial molar. The premolar, probably the third, consists of a high, acute and compressed cone, with rudimentary posterior heel; a cingulum runs entirely around the crown, and is most conspicuous on the anterior surface. This tooth differs from the premolars of most of the European species of *Amphicyon* in the fact that the main cusp has no accessory tubercles developed upon it. The sectorial molar is canine in character; the blade consists of three cusps, of which the external is the larger, and the anterior is very low; the sectorial blade is therefore much less developed than in *Cynodictis*, and hardly more than in *Miacis*; the heel is low and small and not very distinctly basin-shaped. These teeth are insuffi-

cient for a final reference of the specimen, which may possibly belong to *Miacis*, but for stratigraphical reasons I think it more probably a species of *Amphicyon*. *Cynodictis* it certainly is not.

Measurements.

	M.
3d (?) lower premolar, antero-posterior diameter.....	.010
“ “ “ transverse “ .....	.004
1st lower molar, antero-posterior diameter.....	
“ “ “ transverse “	

Another flesh-eater, exceeding the lion in size, is indicated by some metatarsals and phalanges. These may belong to the very large species of *Mesonyx* from the same beds, or to something quite different. No determination can be made at present.

RODENTIA.

Plesiarctomys sciuroides, sp. nov.—Rodents have not as yet been announced from the Uinta deposits; representatives of two genera were, however, obtained by the Princeton party, one of which is the *Plesiarctomys* of the Wasatch and Bridger. In this species the molar formula is $\frac{5}{4}$; it differs from the other species of the genus which Cope defines as having the transverse crests of the upper molars “obsolete or wanting,” in the structure of the upper molars, which are entirely like those of *Sciurus*, and consist of two external cusps, from which run two transverse crests, meeting internally and forming a V. The first upper premolar is very small and single-rooted. The lower molars are very like those of the Bridger species; there are four marginal tubercles surrounding a median depression; the antero-internal cusp is the highest; a low transverse crest connects the anterior pair of tubercles and a less distinct crest the posterior pair. These crests are better marked than in most species of *Plesiarctomys*. The skull has no post-orbital processes and a very large infra-orbital opening; the cranium is broad and flat, without sagittal crest, the inion low and rounded, the zygomatic arches much depressed and very thin, the cerebral hemispheres are entirely unconvoluted and leave the olfactory lobes and cerebellum exposed completely. This species is very small, less in size than *Plesiarctomys delicatissimus*.

Measurements.

	M.
Length of skull.....	.061
Breadth of skull, in front of orbits.....	.025
Length of lower jaw.....	.028
Length upper molar series.....	.013
“ lower “ “ .....	.012
Lower incisor, antero-posterior diameter.....	.003
“ “ transverse “ .....	.002

A second species of rodent is represented by a lower incisor and part of the mandible, but as no molars are preserved, the specimen cannot be referred to any genus. The incisor is very much larger than in any known species of *Plesiarctomys*, and equals that of the beaver in size. It may not improbably belong to some ancestral member of the *Castoridae*, as that family is known to exist in the overlying White River beds.

Measurements.

	M.
Antero-posterior diameter of lower incisor.....	.008
Transverse " " " .....	.0065

ARTIODACTYLA.

Protoreodon parvus, gen. et sp. nov. (?*Agriochœrus* Marsh).—This genus is of interest as being the direct forerunner of the *Oreodontidae*, which are so characteristic of the American Miocene formations. It differs from *Oreodon* in the structure of the upper molars, which have five cusps, an intermediate one appearing between the anterior pair. The crowns of the upper molars are very wide and the internal crescents separated from the external by a considerable interval, much as in *Agriochœrus*. Both upper and lower premolars are somewhat simpler than in *Oreodon*, and the latter are trenchant, as in *Tragulus*. It differs very radically from *Agriochœrus* in the character of the premolars as well as in the presence of the intermediate cusp in the superior molars. The orbit is not enclosed behind, the cranium is narrower and less rounded and the brain smaller than in *Oreodon*. On the other hand, its relationship with that genus is incontestable; the lower teeth form a closed series without any diastemata, the lower canine has gone over to the incisor series, and the first premolar has taken on the form and function of the canine, a peculiarity found only among the *Oreodontidae*. As in that family, the mandible is short, deep, and has an abruptly rounded chin.

The number of digits is uncertain, but is probably v-iv, as is unquestionably the case in *Oreodon*; the magnum has not moved so far to the radical side, but is more directly under the magnum than in the latter genus. In the tarsus the external and median cuneiforms are fused together as in *Oreodon*, but the line of union is much more plainly marked than in that genus.



Protoreodon parvus: Upper molar series, natural size. The inner cusp of the third premolar has been broken away.

This species was of very small size, much inferior to *Oreodon gracilis*.

Measurements.

	M.
Length upper molar series.....	? .053
“ “ premolar series.....	? .026
“ “ true molar “ .....	.027
Length lower molar series.....	.054
“ “ premolar series.....	.027
“ “ true molar “ .....	.027
Antero-posterior diameter, third upper molar.....	.010
Transverse “ “ “ “ .....	.008
Antero-posterior diameter, third lower molar.....	.012
Transverse “ “ “ “ .....	.006

Protoreodon (?) *pumilus* (*Agriochœrus pumilus*) Marsh.*—Professor Marsh has described a species of *Agriochœrus* from the Uinta beds, which more probably belongs to *Protoreodon*; but as the description given is very brief and no mention is made of the very characteristic antero-intermediate cusp on the upper molars, it may possibly be a member of some other genus.

Leptotragulus proavus, gen. et sp. nov.—This genus resembles the White River form *Leptomeryx*, but differs from it in the somewhat less complex structure of the last lower premolar, and in the presence of a strong accessory column between the external cusps of the lower molars. In all probability also this genus had separate metapodials, while in *Leptomeryx* there is a cannon-bone in the hind foot. Apparently the nearest ally of this genus is the *Prodremotherium* of Filhol, with which indeed it may prove to be identical; at present, however, we have judged it best to separate the American species, as aside from the fact that *Prodremotherium* has cannon-bones in both fore and hind feet, the last lower premolar, judging from Filhol's figures,† is somewhat more complex in structure, and less distinctly trenchant than in *Leptotragulus*. The latter is at once distinguished from its cotemporary *Protoreodon*, by the form of the mandible, which is very slender, with tapering chin and diastema behind the canine, while in *Protoreodon* the mandible is deep with abruptly rounded chin and no diastema; a further difference is found in the premolar formula of the lower jaw, four in *Protoreodon*, three in *Leptotragulus*. The premolars resemble most those of the tragulines; the last one consists of a high, sharp and compressed cone, with a very small antero-internal cusp, and a narrow valley on the posterior edge enclosed between two thin plates of enamel; this valley is not complicated by the accessory tubercles found in *Leptomeryx*.

The species *L. proavus* considerably exceeds in size the *Leptomeryx Evansi* of the White River formation, and is somewhat larger than *Tragulus javanicus*. The crowns of the lower molars are low and broad in proportion to their length.

* Am. Jour. Sci. and Arts, 3d Ser., Vol. ix, p. 250.

† Rech. sur les Phosphorites du Quercy, Figs. 265, 266.

The systematic position of this genus can hardly be decided from the material now at command; it may be a forerunner of *Leptomeryx*, the only genus of the White River formation which at all resembles it; it may be an ancestral type of the *Cervidae*, or a member of the traguline series. These questions must for the present be left open.

Measurements.

	M.
Length lower premolar series.....	.021
Last lower premolar, antero-posterior diameter.....	.007
“ “ “ transverse “ .....	.003
First lower molar, antero-posterior diameter.....	.008
“ “ “ transverse “ .....	.005
Length lower true molar series (second specimen). ....	.026
Third lower molar, antero-posterior diameter (second specimen).....	.012

Professor Marsh has named three genera of Uinta ruminants, *Eomeryx*, *Oromeryx* and *Parameryx**, with one of which *Leptotragulus* may be identical. As, however, no definition of these names has as yet been offered, they cannot be used.

PERISSODACTYLA.

Epihippus uintensis Marsh.†—This genus differs from the Bridger *Phiolophus* in having the last two inferior premolars of the molar pattern.

Epihippus gracilis Marsh.—Some beautifully preserved specimens of this small species are in the collection and show interesting differences from the Wasatch *Hyracotherium*. The characteristic equine cusps at the inner angle of the Vs on the lower molars are more isolated and distinct; the limb bones are proportionately longer and more slender; the carpus is higher and narrower; the magnum is more depressed and like that of *Anchitherium* in shape; there are still four digits in the manus, but No. V is very slender; the ulna is still further reduced. *Epihippus* forms a very interesting transition to the horses of the overlying White River deposits.

Hyrachyus obliquidens, sp. nov.—Specimens of this genus are not at all uncommon in the Uinta deposits, but the only ones which can as yet be satisfactorily determined belong to a species different from any of the known Bridger species. This species is characterized by the last upper molar, which has become exceedingly oblique and very like the corresponding tooth of *Aceratherium*; the antero-external lobe is greatly reduced in size, the external wall of the crown is nearly parallel to the posterior transverse crest and prolonged but little beyond it, so that the posterior valley is almost obsolete, being even less developed than in

* Introd. and Succ. of Vert. Life in America, pp. 29, 30.

† Loc. cit., p. 24.

Hyracodon. The rest of the dentition shows no particular deviation from the usual type, nor are important differences from the Bridger species observable in the skeleton, except perhaps a slight reduction in the relative size of the lateral digits. In size this species about equals *H. agrarius*.

Prothyracodon intermedium, gen. et sp. nov.—This very interesting type is apparently intermediate between *Hyrachyus* and *Hyracodon*. The type specimen consists of a fragment of the superior maxillary containing the fourth premolar and second molar in place, with the alveolus of the first molar. As in *Hyrachyus* the premolar has but a single internal cusp and two transverse crests enclosing a valley. The external cusps are like those of *Hyracodon*, the outer wall of the crown being nearly flat and subquadrate in outline; the two constituent cusps are but faintly indicated, but are somewhat more pronounced than in *Hyracodon*. An antero-external buttress or fold of the cingulum is present, as in both the Bridger and White River genera.

The second molar is essentially the same as in *Hyracodon*; the antero-external lobe is much more reduced than in *Hyrachyus*, and the transverse crests directed more obliquely inwards and backwards; but on the other hand, the projection from the anterior crest into the median valley which is to be seen on all the molars of *Hyracodon* is here wanting.

The present species is quite small; it is about the size of *Hyrachyus agrarius*.

Measurements.

	M.
Fourth upper premolar, antero-posterior diameter.....	.010
“ “ “ transverse “ .....	.014
Second upper molar, antero-posterior diameter.....	.016
“ “ “ transverse “ .....	.0175

Isectolophus annectens, gen et sp. nov.—This genus is closely allied to *Helaletes* of the Bridger, but its dentition is one step nearer to that of the tapir. In *Helaletes* the antero-external cusp of the upper molars is less reduced and there is less difference between that and the postero-external cusp, than in *Hyrachyus*. This tooth structure would almost suffice to remove *Helaletes* from the *Lophiodontidæ* as defined by Cope. In *Isectolophus* this equality of the external cusps is still better marked, and, more important still, the external wall is extended behind the posterior pillar just as in the tapir, so that this pillar becomes a median thickening of the postero-external cusp, instead of being a thickening of the posterior edge of that cusp, as in *Hyrachyus* and *Helaletes*. The first and second upper molars are thus almost exactly like those of the tapir; the transverse crests are low and thick, and a strong cingulum surrounds the crown. The premolars are probably all simpler than the molars; at all events this is true of the third. The lower molars are like those of *Helaletes*, and the last one has a well-developed heel or third crest; there seems, how-

ever, to have been a diastema between the canine and first premolar, though this is not certain, which is not the case in *Heleletes*.

The species is rather small, somewhat larger than *Heleletes latidens* of the Bridger.

Measurements.

	M.
Length upper molar series.....	.048
First molar, antero-posterior diameter (?).....	.015
“ “ transverse “ (?).....	.015
Second “ antero-posterior “ .....	.015
“ “ transverse “ .....	.014
Third “ antero-posterior “ .....	.016
“ “ transverse “ .....	.018
Third upper premolar, antero-posterior diameter.....	.012
“ “ “ transverse “ .....	.011
Third lower molar, antero-posterior “ .....	.023
“ “ “ transverse “ .....	.011

The study of this genus shows that *Hyrachyus* and *Desmatotherium* cannot be placed in the direct line of tapir ancestry, as we were formerly disposed to believe. Much more probably this line has come down through the genera with trilobed last lower molar, and it is noteworthy that the tapiroids from the White River beds have the third lobe or talon present, though less distinctly marked. These animals have been described by Dr. Leidy,* under the name of *Lophiodon*, from which genus the known specimens do not appreciably differ. But, as Dr. Leidy has suggested, they probably belong to a very different genus, which, when better known, will in all likelihood be found to be intermediate in character between *Isectolophus* of the Uinta and *Tapiravus* of the Loup Fork. According to this view the series of genera would be: *Heleletes*, *Isectolophus*, the White River genus, *Tapiravus* and *Tapirus*.

Amynodon Marsh (*Syn. ? Orthocynodon*, nobis).—Professor Marsh's description of this genus is as follows:† “The skull is intermediate in form between that of a Tapir and a Rhinoceros, but the molar teeth are entirely of the latter type. The premolars are all unlike the molars, and the canines above and below are very large. The incisors are small and the inner one in each jaw is lost in the present adult animal. The lower canines are placed nearly horizontal, and, taken in connection with the rest of the anterior dentition, they prove conclusively that the large lower teeth usually regarded as incisors in *Aceratherium* * * * are really canines.” The number of digits is stated to be iv–iii. This description is erroneous in most of the particulars, owing to the fact that it was drawn up before the type specimen had been removed from the matrix and put together, and in this way, even after examining the type ourselves, as

* Ext. Mamm. Faun. of Dak. and Neb., p. 239.

† Am. Journ. Sci. and Arts, Third Ser., Vol. xiv, p. 251.

Professor Marsh kindly allowed us to do, we were formerly led to consider the Bridger species as a distinct genus* (*Orthocynodon*).

The numerous specimens from the Uinta formation now in the Princeton collection show that *Orthocynodon* is very probably identical with *Amynodon*. The premolars are not all unlike the molars, as the third and fourth of the upper premolar series have all the molar elements, but are somewhat smaller; the incisors are present in their full number in the upper jaw; the lower canines are not procumbent but fully erect. We can therefore confirm Professor Marsh's statements only with regard to the pattern of the molar teeth and probably also as to the number of digits.

Amynodon advenus Marsh is the only species as yet known from the Uinta beds, in which, especially in the higher strata, it is very abundant.

Diplacodon elatus Marsh.†—This animal, the largest yet known from the Uinta, is of especial interest as being intermediate between the Chauliherioids of the Bridger (*Palaosyops*, *Leurocephalus*, etc.), and the gigantic *Menodontia* of the White River, as was first suggested by Professor Marsh. The dentition is like that of *Palaosyops*, but the premolars have commenced to assume the molar pattern; there are, however, no traces of the horn-like processes so characteristic of *Menodus*. The skeleton, which is very fully represented in the collection, is massive, and in many respects closely like that of *Menodus*. The cervical vertebrae are short, with opisthocelous centra and quite long spines; the dorsal vertebrae are heavy and in the anterior region have very long spines, which, however, do not reach the extreme length found in *Menodus*; the lumbar are rhinocerotid in character; the ribs are long, flattened and heavy. The scapula is, like that of *Menodus*, very rhinocerotid, long and narrow, but with more abruptly rising spine and rudimentary metacromion; the humerus is very massive, with strongly developed deltoid hook and supinator ridge; this humerus is a somewhat reduced copy of that of *Menodus*; the ulna is stout for its entire length and has a very prominent olecranon; the radius differs in no essential except size from that of *Menodus*; the carpus is low and broad, the metacarpals and phalanges like those of *Palaosyops*, only stouter. The pelvis is like that of *Palaosyops*, with long, pedunculate and plate-like ilium, which is not everted nearly so much as in *Menodus*, and long, heavy and trihedral ischium; the femur is long and massive, with very prominent third trochanter, and with the rotular trochlea narrower and deeper than in *Menodus*; the tibia is shorter than the femur; the calcaneum has a very long tuber calcis and a narrow cuboidal facet, considerably narrower than in *Palaosyops*; it appears also to possess the distinct fibular facet which is found in *Menodus*; the astragalus is broader and shallower than in *Palaosyops*, and has a more exten-

* Bull. E. M. Museum, No. 3, pp. 1 *et seq.*

† Am. Journ. Sci. and Arts, 3d Ser., Vol. ix, p. 246. Introd. and Succ. Vert. Life, p. 27.

sive bearing upon the cuboid, while it is narrower than in *Menodus*, and has a less extensive contact with the cuboid. The number of digits is apparently iv-iii.

The characters revealed by this skeleton abundantly confirm Professor Marsh's view that *Diplacodon* is to be regarded as the ancestor of *Menodus*, and as a descendant of the Bridger Chalicotherioids.

The Uinta fauna differs in many very important respects from that of the Bridger formation, both in what it possesses and in what it lacks; nevertheless it is on the whole more closely akin to the Bridger than to the White River fauna. The great *Dinocerata* seem to have completely disappeared, as have also the *Tillodonta*; rodents, lemuroids, and creodonts are very much less common than in the Bridger, and what seem to be the first true American carnivores have appeared; perissodactyls of chalicotherioid, lophiodont, equine and rhinocerotid types are still very numerous. But the most remarkable and striking change consists in the extraordinary increase in the number of selenodont artiodactyls, which are exceedingly rare in the Bridger, but in the Uinta are perhaps more abundantly represented, as far as individuals are concerned, than any other group of mammals; in character these artiodactyls are distinctly like those of the White River epoch. As yet no bunodont artiodactyls have been discovered, though they doubtless existed. With the possible exception of *Agriochoerus* (see p. 257), no genus is yet known which is common to the White River and Uinta formations, while several Bridger genera are represented in the latter; there are *Plesiarctomys*, *Mesonyx*, *Hyrachyus*, *Amynodon*, and perhaps others. No perissodactyl in which the premolars have all taken on the molar pattern, and no artiodactyl with coalesced metapodials, is known in this fauna, which thus has a distinctly older facies than the fauna of Quercy,* which, however, agrees with it in the great increase in selenodonts. Schlosser† considers the Uinta fauna as Oligocene, but, as we believe, without good reason, since not a single Miocene genus has been found in it, the genera being all either common to the Bridger or peculiar to the Uinta. The term oligocene is much more properly applied to the overlying White River beds, as has been done by Messrs. Cope and Filhol.‡ It seems, therefore, best on the whole to regard the Uinta as forming the summit of the eocene, as Professor Marsh, who first described its fauna, has done.

Synopsis of the Uinta Fauna.

	Genera.	Species.
<i>Rodentia</i>	2	2
<i>Lemuroidea</i>	1	1
<i>Creodonta</i>	1	1

* Filhol Phosph. du Quercy, pp. 517-554.

† Morph. Jahrb., Bd. xii, p.

‡ Bibl. de l'École d. Hautes Études; Sect. d. Sci. Nat. T., xix, p. 21 (separatim).

	Genera.	Species.
<i>Carnivora</i> (?).....	1	1
<i>Artiodactyla</i>	2	3
<i>Perissodactyla</i>	6	7
	<hr/> 13	<hr/> 15

For the very extensive and valuable collections of Uinta fossils now preserved in the Princeton museum, of which a brief account has been given above, we are chiefly indebted to the energy and skill of Mr. Francis Speir, Jr., of New York, who was in charge of the expedition of 1886.

GEOLOGICAL MUSEUM, PRINCETON, N. J., July 12, 1887.

On the Systematic Position of the Mallophaga. By A. S. Packard.

(Read before the American Philosophical Society, September 2, 1887.)

The true position of the bird-lice has been in debate for many years, and it is only recently that, in the excellent essay of Grosse,* we have such an exact account of the mouth-parts of these insects, as to enable us to perceive that they have been wrongly referred to the Hemiptera. With the new information afforded by Grosse, who does not himself add any general conclusions as to the systematic position of the Mallophaga, beyond stating that they are not Hemiptera, nor allied to the true lice, we have for our own satisfaction made some comparisons with the Psocidæ, to which, among winged insects, the parasites in question seem nearest allied.

The name *Mallophaga* was first proposed by Nitzsch in Germar's "Mag. der Entomologie," iii, 270, 1812.† In Gerstaecker's "Arthropoden" of Peters and Carus' "Handbuch der Zoologie" (1863), where this group is placed with the lice among the Hemiptera, it is stated that Burmeister regarded the Mallophaga as Orthoptera: "Zwischen welchen und den Hemipteren sie in Anbetracht ihrer Verwandtschaft mit den Läusen ein Uebergangsglied abgeben, ohne füglich einer von beiden Ordnungen direct zugewiesen werden zu können."

In our "Guide to the Study of Insects" (1868), and in subsequent editions, influenced by general usage and also by Melnikow's arguments, based on embryological studies, we placed the Mallophaga among the Hemiptera, next to the true lice. In most, if not all German, Dutch, and French, as well as English text-books, the Mallophaga, if referred to, are described with the true lice. But, in his article, "Insects," in the "Encyclo-

* Beiträge zur Kenntniss der Mallophagen. Von Dr. Franz Grosse. Zeits. für wissen. Zool., xlii, 1885, pp. 530-558. A lengthy illustrated abstract by Prof. G. McCloskey will be found in the American Naturalist, April, 1886, pp. 340-348.

† I am indebted to Dr. Hagen for this reference to Nitzsch's paper.